# Understanding Swap Pricing and Calculating Risk

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# Swap Math and Procurement

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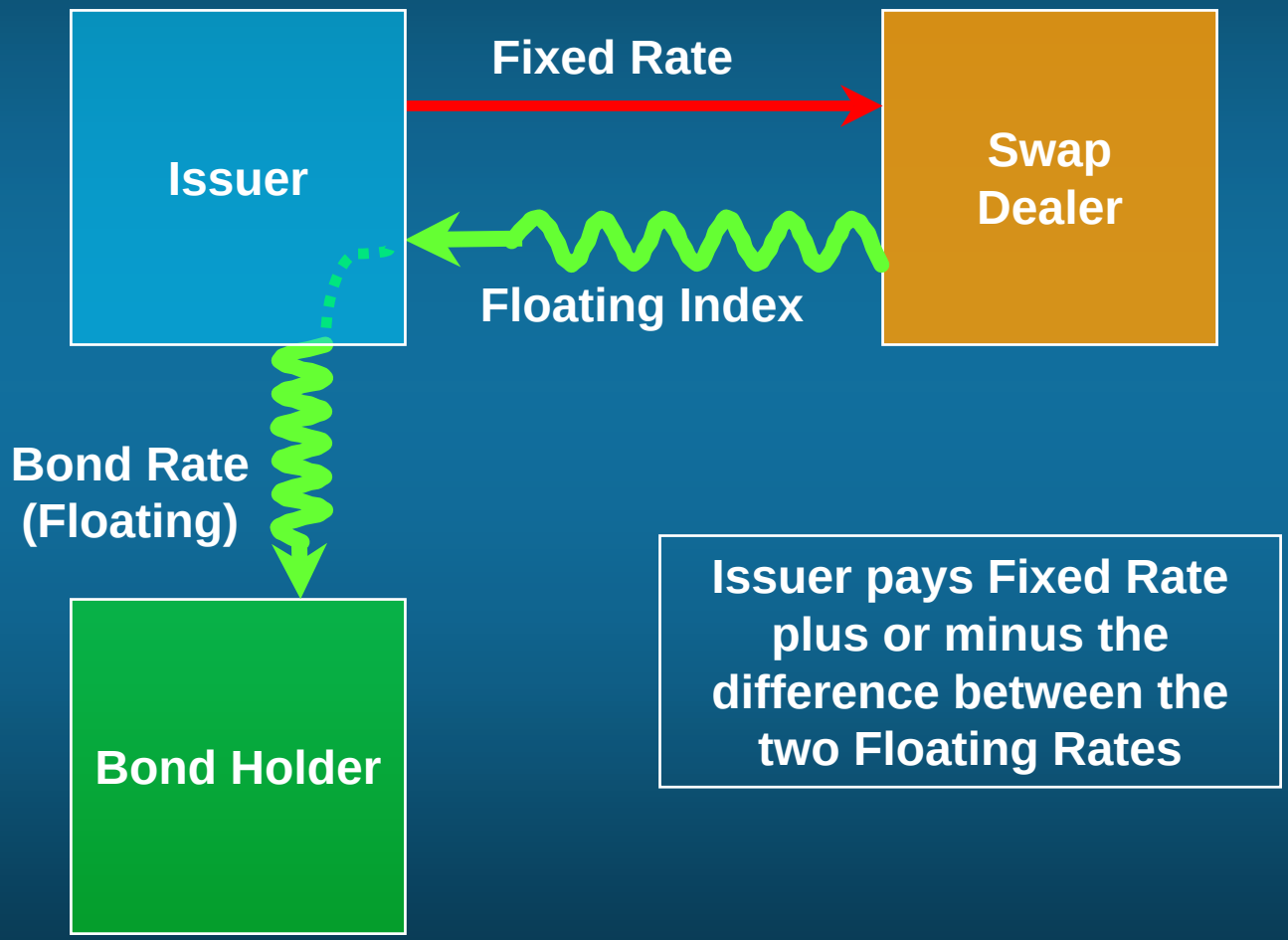
# Swap overview



# Basic math: swaps vs. bonds

Bonds

- ✓ Fixed coupon
- ✓ + Amortized cost of issuance

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- ✓ = All-in cost

Swap

- ✓ Floating bond rate
- ✓ + Annual costs of floaters (remarketing/ liquidity, auction fees)
- ✓ + Fixed swap rate
- ✓ – Floating swap rate

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- ✓ = All-in cost

# Plug in some numbers

Bonds

- 4.34% (fixed coupon)
- + 0.05% (amortized cost of issuance)

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- = 4.39% (all-in cost)

Swap

- VR% (floating bond rate)
- + 0.26% (remarketing and liquidity or auction)
- + 3.49% (fixed swap rate)
- – VR% (floating swap rate)

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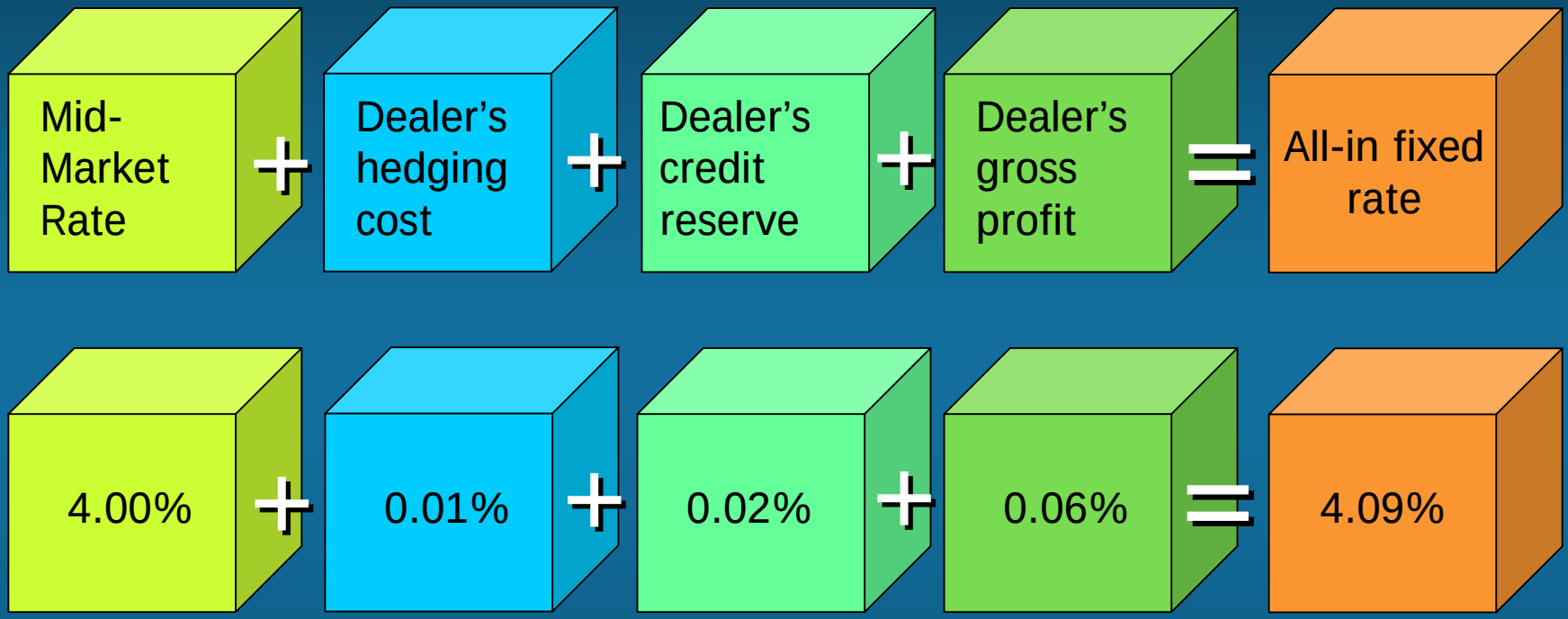
- = 3.75% (all-in cost)

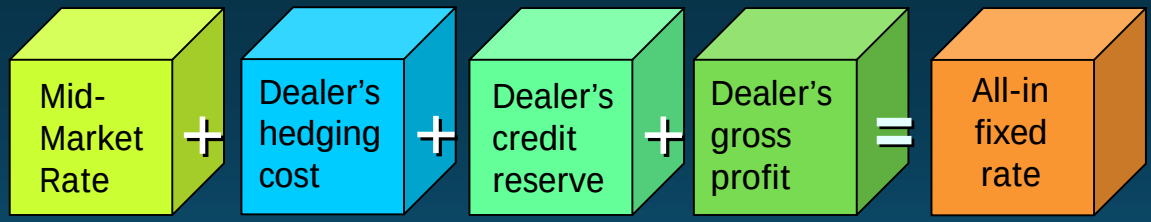
# Why does it work?

- Counter-intuitive: Why should three steps (issue floating, receive floating, pay fixed) be more efficient than one (issue fixed)
- Swaps allow you to “unbundle” and take advantage of relative efficiencies of different markets
- Market sensitive: It doesn’t always work

# Building blocks of swap pricing




- 30yr BMA swap example
  - Actual component values will vary widely based on deal specifics




- What is "mid-market"?
  - Hypothetical rate for swap if no profit or costs
  - Supposedly the "objective" rate that all parties can agree on
  - Calculated by averaging bid and offered rates
    - Bloomberg screen for 30-year BMA swap:
      - Bid: 3.95%, Offer: 4.06%
      - Thus, mid-market is 4.005%

# BMA swap quotes

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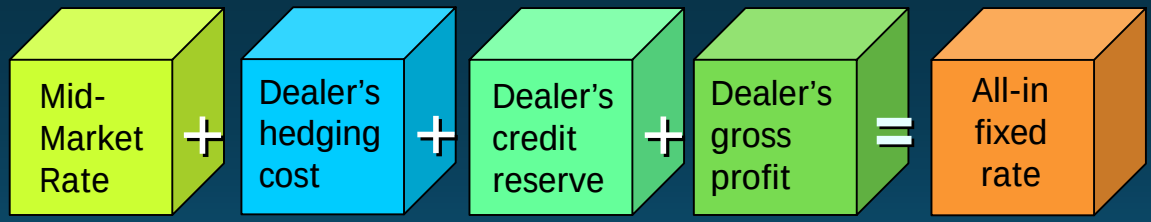
| Term | | Bid | Ask | Time | | Bid | Ask | Time |
|---|---|---|---|---|---|---|---|---|
| Percentage of Libor vs BMA Muni Index | | | | | Quarterly Bond Rate vs BMA Muni Index | | | |
| 1Y | 1) | 65.38 | 68.38 | 2/09 | 12) | 3.52 | 3.68 | 2/09 |
| 2Y | 2) | 66.00 | 69.00 | 2/09 | 13) | 3.46 | 3.61 | 2/09 |
| 3Y | 3) | 66.38 | 69.38 | 2/09 | 14) | 3.44 | 3.59 | 2/09 |
| 4Y | 4) | 66.75 | 69.75 | 2/09 | 15) | 3.45 | 3.60 | 2/09 |
| 5Y | 5) | 67.25 | 70.25 | 2/09 | 16) | 3.48 | 3.63 | 2/09 |
| 7Y | 6) | 68.75 | 70.75 | 2/09 | 17) | 3.58 | 3.68 | 2/09 |
| 10Y | 7) | 69.88 | 71.88 | 2/09 | 18) | 3.68 | 3.78 | 2/09 |
| 12Y | 8) | 70.50 | 72.50 | 2/09 | 19) | 3.74 | 3.84 | 2/09 |
| 15Y | 9) | 71.13 | 73.13 | 2/09 | 20) | 3.80 | 3.91 | 2/09 |
| 20Y | 10) | 72.13 | 74.13 | 2/09 | 21) | 3.88 | 3.99 | 2/09 |
| 30Y | 11) | 73.25 | 75.25 | 2/09 | 22) | 3.95 | 4.06 | 2/09 |

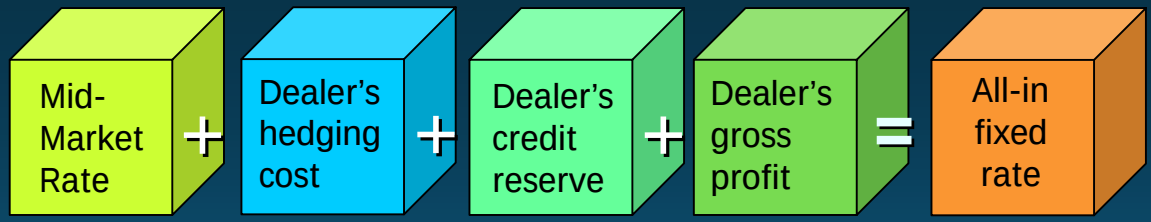
# LIBOR swap quotes

GovPX/ICAP SwapPX — US Medium Term Swaps vs 3M LIBOR

| Term | TrPrice | TrYld | SwapSpd-SA | | SA (30/360) |
|---|---|---|---|---|---|
| 2Y | 99.300/304 | 4.908 /899 | 34.75 | 38.75 | 5.251 /291 |
| 3Y | 99.264/270 | 4.812 /807 | 37.75 | 41.75 | 5.187 /227 |
| 4Y | | 4.794 /789 | 38.50 | 42.50 | 5.176 /216 |
| 5Y | 99.284/290 | 4.775 /771 | 41.25 | 45.25 | 5.186 /226 |
| 6Y | | 4.777 /773 | 42.50 | 46.50 | 5.200 /240 |
| 7Y | | 4.779 /775 | 44.25 | 48.25 | 5.219 /259 |
| 8Y | | 4.780 /776 | 46.00 | 50.00 | 5.239 /279 |
| 9Y | | 4.782 /778 | 47.75 | 51.75 | 5.258 /298 |
| 10Y | 98.240/250 | 4.784 /780 | 49.75 | 53.75 | 5.280 /320 |
| 11Y | | 4.784 /780 | 51.50 | 55.50 | 5.297 /337 |
| 12Y | | 4.784 /780 | 53.25 | 57.25 | 5.315 /355 |
| 13Y | | 4.784 /780 | 55.00 | 59.00 | 5.332 /372 |
| 14Y | | 4.784 /780 | 56.25 | 60.25 | 5.345 /385 |
| 15Y | | 4.805 /801 | 55.75 | 59.75 | 5.360 /400 |
| 20Y | | 4.825 /822 | 57.25 | 61.25 | 5.396 /436 |
| 25Y | | 4.845 /843 | 56.50 | 60.50 | 5.409 /449 |
| 30Y | 98.054/064 | 4.866 /864 | 54.50 | 58.50 | 5.410 /450 |




- Problems with mid-market
  - Moving markets are often not reflected on screens (especially BMA)
  - Capability of advisor/issuer in modeling
  - Different models can produce different results with non-vanilla transactions (especially swaps with embedded options)




- Dealer spread components
  - Hedging cost
    - Varies by index, product type, even by dealer
  - Credit reserve cost
    - Required for all credit exposures
    - Varies somewhat by dealer
    - Spread between different credits can vary over time
  - Profit
    - Evolving practices, no real standard
    - Spread will often be larger for small deals and for deals that consume a large amount of time

# Calculating mid-market rate

| | |
|---|---|
| Notional: | $100 million (non-amortizing) |
| Trade Date: | 3/7/2007 |
| Effective Date: | 4/1/2007 |
| Termination Date: | 4/1/2009 |
| Fixed leg: | ____% (Semi-annual payments, 30/360 daycount fraction) |
| Floating leg: | 6-month USD LIBOR (Semi-annual payments, Actual/360) |

- Mid-market swap rate is the rate at which the discounted future values of the fixed and floating swap payments net to zero

# Swap cashflows

| Date | Days | Floating Rate Payment | Fixed Rate Payment |
|---|---|---|---|
| 4/1/2007 | 0 | none | none |
| 10/1/2007 | 183 | $6ML_0$ x 183/360 x $100mm | -Fixed% x 180/360 x $100mm |
| 4/1/2008 | 183 | $6ML_1$ x 183/360 x $100mm | -Fixed% x 180/360 x $100mm |
| 10/1/2008 | 183 | $6ML_2$ x 183/360 x $100mm | -Fixed% x 180/360 x $100mm |
| 4/1/2009 | 182 | $6ML_3$ x 182/360 x $100mm | -Fixed% x 180/360 x $100mm |

- Payments are made at the end of each period
- LIBOR rates are determined 2 London business days prior to the start of each period (as per ISDA convention)
- Thus, the first 6-month LIBOR setting ($6ML_0$) is determined on (3/29/07)
- Only net payment is exchanged on payment dates (according to appropriate business day convention)

# Calculating mid-market rate

- Swap can be decomposed into two parts:
  - Fixed rate bond paying fixed swap rate
  - Floating rate note (FRN) paying LIBOR
    - To estimate the NPV of the swap, we need the PV of each leg (fixed and floating)
    - LIBOR rates are derived from the forward curve
    - Principal repayments at maturity cancel out
    - Solve for the swap rate where the PV of the future cashflows for the FRN equal those of the bond

# Floating leg

- FRN cashflows valued using forward curve
  - Use forward LIBOR rates to generate cashflows
  - Discount back using corresponding discount factors
  - This gives the NPV of the floating side
- Forward rates are market perception of future spot rates
  - Historically, not a good predictor
  - Dealers can hedge off forward rates
    - Using Eurodollar futures, FRAs, swaps etc.

# Floating leg (con't)

- Calculate floating leg NPV
  - Discount factors and forward rates are derived from the yield curve

| Date | Days | DF | Forward DF | Forward Rate | Cashflows | PV Cashflows |
|---|---|---|---|---|---|---|
| 4/1/2007 | 0 | 0.996396 | | | | |
| 10/1/2007 | 183 | 0.969473 | 0.972980 | 5.4630% | 2,777,024.22 | 2,692,250.00 |
| 4/1/2008 | 183 | 0.944098 | 0.973826 | 5.2874% | 2,687,750.64 | 2,537,500.00 |
| 10/1/2008 | 183 | 0.920633 | 0.975145 | 5.0141% | 2,548,845.49 | 2,346,550.00 |
| 4/1/2009 | 182 | 0.897167 | 0.974512 | 5.1735% | 2,615,510.82 | 2,346,550.00 |
| | | | | | | |
| | | | | | **NPV:** | 9,922,850.00 |

# Fixed leg

- Solve for the fixed rate that produces same NPV as the floating leg

| Date | Days | DF | Cashflows | PV Cashflows |
|---|---|---|---|---|
| 4/1/2007 | 0 | 0.996396 | | |
| 10/1/2007 | 183 | 0.969473 | 2,659,304.40 | 2,578,123.82 |
| 4/1/2008 | 183 | 0.944098 | 2,659,304.40 | 2,510,643.97 |
| 10/1/2008 | 183 | 0.920633 | 2,659,304.40 | 2,448,242.06 |
| 4/1/2009 | 182 | 0.897167 | 2,659,304.40 | 2,385,840.15 |
| | | | | |
| Fixed Rate | | 5.319% | **NPV:** | 9,922,850.00 |

Total swap NPV = Floating NPV – Fixed NPV = 0

With mid-market fixed rate of 5.319%

# Procurement: Negotiation/Competition

- Role of swap advisor
  - Usually client knows which way he wants to go
  - Often, we are brought in after the dealer has been chosen – sometimes, much after
  - Client often uses us to confirm his judgment
  - Our experience: 75% of governments use competition (non-profits are reverse)

# Why negotiate?

- Comfortable with current banking team, issuer may be inclined to enter into first swap with group they know
- A key financial relationship is overwhelmingly the most common reason clients negotiate swaps

# Why negotiate?

- I want to give the business to someone who brought in a great idea
- Much less common, as there are few truly original ideas
  - The best ideas are not original product ideas
  - Instead, they are for ways to apply a product to a client's individual circumstances
  - We believe clients mostly reward bankers who take the time to understand client needs

# Why negotiate?

- My deal could move the market if I bid it competitively
- Also less common, but can occur if:
  - Deal is very large
  - Deal is in a relatively illiquid part of the market

# Why compete?

- My only goal is best price
- If deal won’t move market, competition usually provides best pricing
- Issue: It may take more time to qualify bidders (get agreement on key documentation issues)

# Case Study: California DWR

- September 2005
- $2,594,000,000 (amortizing)
- DWR pays fixed, receives 66% of 1 mo. LIBOR
- Agency wanted to compete broadly, diversify among 5 or more dealers
- Went out to 17 dealers
- Winners were all non-relationship banks
- Agency's key relationships were ticked off

# Why compete?

- I need to demonstrate I achieved best price
- Very common reason, esp. in governmental market
- Alternative: Fairness Opinion

# Why compete?

- My product is so unusual that fair price is very hard to establish without competition
- Real rarity, but sometimes happens

# Case Study: NewYork-Presbyterian

- September 2005 / November 2006
- $58,775,000 / $174,990,000
- 30-Year BMA cap: NYP pays upfront premium, receives excess of BMA Index over 6.00% for any month over the next 30 years
- No one ever did a 30-year BMA cap before
- Price estimates varied enormously

# Bid results: March 2005

| Dealer | 30-Year BMA Cap |
|---|---|
| JPMorgan | 367 bps |
| Bear Stearns | 380 bps |
| BNP Paribas | 413 bps |
| Merrill Lynch | 446 bps |
| Bank of America | 468 bps |
| Bank of New York | 471 bps |
| Lehman Brothers | 515 bps |

# Bid results: November 2006

| Dealer | 30-Year BMA Cap |
|---|---|
| Lehman Brothers | 241 bps |
| Royal Bank of Canada | 247 bps |
| BNP Paribas | 255 bps |
| JPMorgan | 260 bps |
| Bear Stearns | 274 bps |
| Bank of New York | 291 bps |
| Merrill Lynch | 293 bps |
| Bank of America | 294 bps |
| Bank of Montreal | 329 bps |